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GB 2251234 A GB 2231028 A GB 2184707 A
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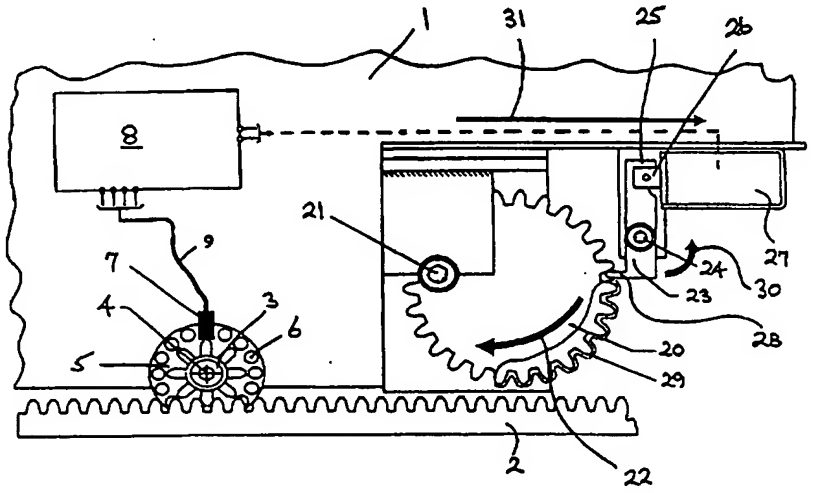
(54) Abstract Title
Braking system for stairlift

(57) A braking system, suitable for use with a stair lift, comprising a carriage (1) and a track (2) along which the carriage moves, comprises a means (3,5,7) of generating a signal corresponding to the speed of movement of the carriage. A means (8) is provided to monitor the signal and compare it with a predetermined value. The system includes a braking device (20) which prevents relative movement of the carriage and track when the signal departs from the predetermined value.

Preferably, the braking device comprises an eccentrically mounted spur gear 20 held out of engagement by a pinion 23 spring-pressed away from the gear and held in engagement by solenoid 27. Preferably, the signal is a pulsed optical one and the monitoring means 8 a microprocessor.



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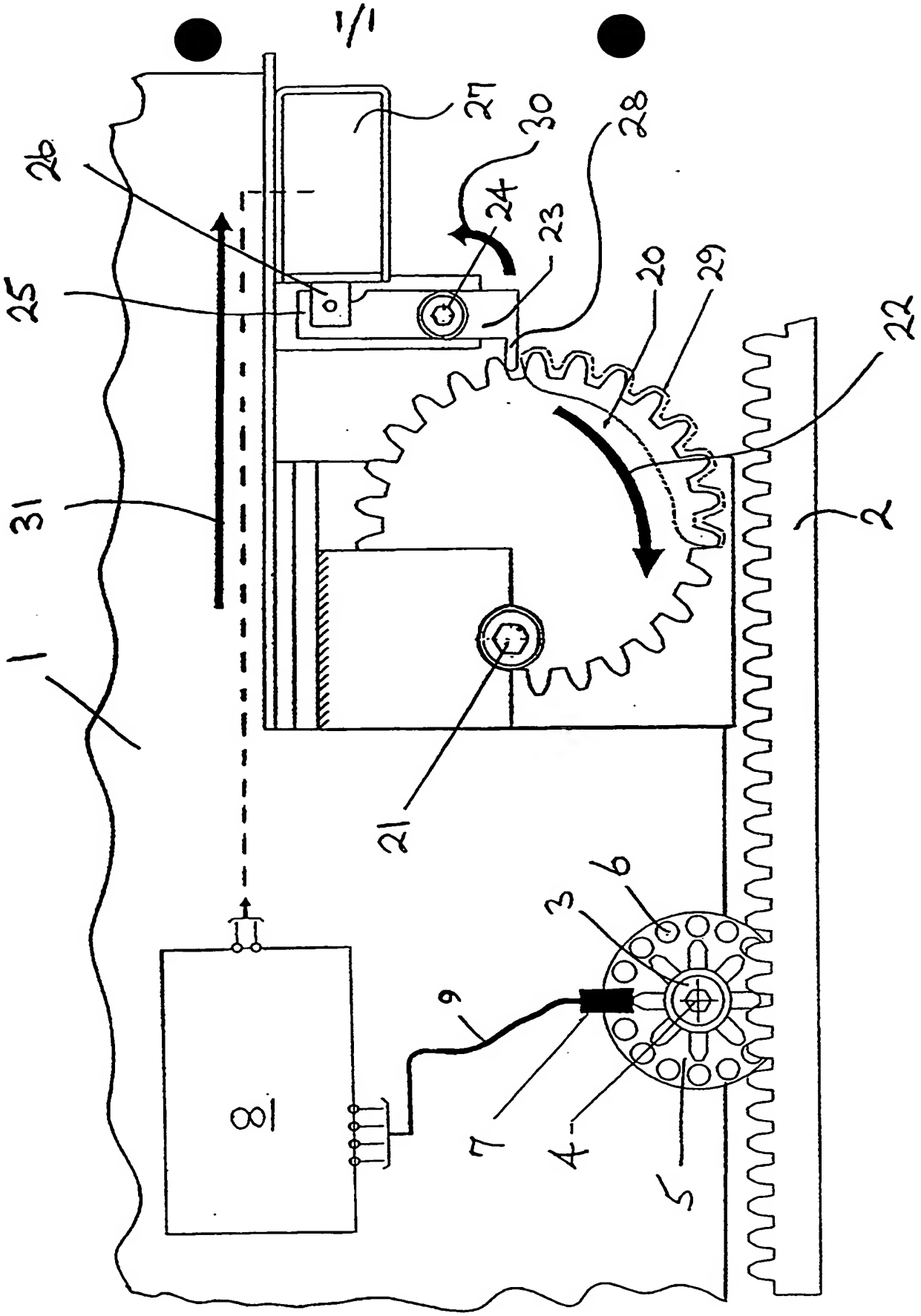
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.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IMPROVEMENTS IN OR RELATING TO BRAKING SYSTEMS

This invention relates to braking systems and more particularly, but not exclusively, is concerned with an emergency braking system for a stair lift.

Stair lifts are well known and are generally installed on an existing stairway to enable the infirm and elderly to more readily move from one storey of a building to another. Ordinarily, the stair lift includes a carriage upon which is mounted a seat for the passenger and which is caused to move along a track by a suitable electric motor. In the interests of safety, and as required by British Standard BS5776:1996, a braking system is needed to prevent uncontrolled descent should there be a power failure or a motor malfunction.

It is an object of the present invention to provide such a braking system.

According to one aspect of the present invention there is provided a braking system for preventing relative movement between a movable first member and a second member which system comprises:-

(i) a means of generating a signal in the form of a series of pulses at a speed dependent upon the rate of movement of the first member with respect to the second member,

(ii) monitoring means for monitoring the signal and comparing it with a predetermined value, and

(iii) a braking device for preventing relative movement of the first and second members when the signal departs from the predetermined value.

The pulses may be optical pulses generated by chopping a light beam by means of an apertured disc rotating in the light beam at a speed dependent upon the speed of movement of the first member. The optical pulses may be converted to electrical pulses by

suitable amplifying circuitry.

The monitoring means may be in the form of a microprocessor to which the signal is fed. In the above embodiment the microprocessor monitors the pulses and determines whether or not they are at a rate within a range of predetermined values which may be preselected as desired. In the event that the pulse rate is not within the predetermined range of values, then the braking device is actuated.

Preferably, the braking device comprises a toothed member, such as a gearwheel, eccentrically mounted on the first member so that it can pivot between a braking position in which the toothed member engages with a corresponding rack provided on the second member to prevent relative movement between the first and second members and a non-braking position where the toothed member is spaced from the rack. The mounting of the toothed member is such that it tends to adopt its braking position under the force of gravity. A means, such as a torsion spring, may also be provided to urge the toothed member into its braking position. The toothed member may ordinarily be held in its non-braking position by an abutment moveable between a position where it engages the toothed member and holds it in its non-braking position and a position where it is spaced from the toothed member. The abutment is preferably spring loaded or otherwise biased towards the position where it is spaced from the toothed member and hence does not retain the toothed member in its non-braking position. The abutment may be operated by a solenoid in which case the solenoid is preferably such that it is in its energised state when retaining the toothed member in its non-braking position, the solenoid being maintained in its energised state when the monitoring means determines that the signal satisfies the predetermined value.

That part of the toothed member which contacts the rack when the toothed member is in its braking position is preferably coated with a suitable material, such as a thermoplastics material, to absorb the initial impact shock. Because of the eccentric mounting arrangement of the toothed member, any tendency of the first member to move with respect to the second member results in the toothed member becoming further mechanically engaged with the rack thereby increasing the restraining force preventing relative movement.

The braking device as above described may be used in a braking system wherein the generated signal is other than a signal in the form of a series of pulses. Accordingly, another aspect of the present invention provides a braking system for preventing relative movement between a movable first member and a second member which system comprises:-

(i) signal generating means for generating a signal corresponding to the speed of movement of the first member with respect to the second member,

(ii) monitoring means for monitoring the signal and comparing it with a predetermined value, and

(iii) a braking device for preventing relative movement of the first and second members when the signal departs from the predetermined value, said braking device comprising a toothed member eccentrically mounted on the first member so that the toothed member can move between a braking position in which it is engaged with a rack provided on the second member and thereby prevents relative movement of the first and second members and a non-braking position in which it is spaced from the rack.

The braking system of the present invention is particularly suitable for stair lifts in which case the movable first member comprises the stair lift carriage and the second member comprises a track along which the

carriage moves. The braking system is mounted on the carriage.

For a better understanding of the invention and to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawing which shows, in diagrammatic form, a part of a stair lift including a braking system in accordance with the present invention.

Referring to the drawing, there is shown a part of a stair lift comprising a carriage 1 having a seat (not shown) for a passenger mounted thereon and mounted for movement along a track in the form of a beam-mounted rack 2. The carriage 1 also includes a 24v dc motor (not shown) which drives a pinion (not shown) engaged with the rack 2 to propel the carriage along the rack in either direction as desired in a conventional manner. In the drawing, arrow 31 indicates the downhill motion of the carriage.

A pinion 3 formed of a linear polyamide (nylon) or other suitable material is mounted on the carriage 1 so that it is rotatable about axle 4 and so that it can engage with the rack 2. The pinion 3 acts purely as a follower wheel and is rotated as the carriage 1 moves along the rack 2. The pinion 3 forms part of a mechanism for chopping a light beam into discrete light pulses which comprises an opto disc 5 mounted on the axle 4 for rotation with the pinion 3. The opto disc 5 has a diameter of 50mm and is formed from sheet steel of thickness 0.9mm. It has 16 equi-spaced holes 6 punched therein. Each hole 6 has a diameter of 6.1mm and the holes are located on a 42mm diameter circle. The chopping mechanism includes a slotted opto switch 7 (e.g. Type Honeywell HOA6990-T51) which is mounted so that the periphery of the disc 5 is located in the slot of the switch 7. The switch 7 generates a beam of light which can pass through the disc 5 only when one

of the holes 6 is disposed within the slot of the switch 7. Thus the light beam is chopped into a series of light pulses as the disc 5 rotates and the frequency of the light pulses is proportional to the speed of rotation of the disc 5 (which is proportional to the speed of movement of the carriage 1 along the rack 2). The opto switch 7 includes amplifier circuitry which converts the series of light pulses to a series of electric pulses.

Also mounted on the carriage 1 is a PIC microcontroller 8 comprising a printed circuit board including a programmable integrated circuit. An example of a suitable PIC micro controller is Type Microchip PIC16C74-04P. The opto switch 7 is operably connected to the microcontroller 8 by lead 9 and includes circuitry for monitoring the number of pulses generated by the opto switch 7 and for comparing them with a predetermined value.

A braking device is also mounted on the carriage 1. This comprises a toothed member in the form of a machined spur gear pinion 20 mounted about eccentrically positioned axle 21 secured to the carriage. The spur gear 20 thus tends to drop under the influence of gravity to a braking position where its gear teeth engage with the teeth of the rack 2. A torsion spring (not shown) is provided to urge the spur gear pinion 20 in the direction of the arrow 22 to assist in biasing the spur gear pinion 20 towards its braking position.

A pawl 23 is mounted on the carriage 1 so that it can pivot about axle 24 between first and second positions. One end 25 of the pawl is secured to the armature 26 of a 24v dc solenoid 27 and the second end of the pawl includes an abutment 28 capable of engaging between adjacent teeth of the spur gear pinion 20 when the pawl is in its first position thereby retaining the

spur gear pinion 20 in its non-braking position as shown in the drawing. The pawl 23 is biased by means of a torsion spring (not shown) in the direction shown by arrow 30 so that it tends to adopt its second position where the abutment 28 is withdrawn from the teeth of spur gear pinion 20, when not held in its first position by the solenoid 27. A micro-switch (not shown) is provided which monitors the position of the pawl 23. The micro-switch is mounted in proximity to the spur gear pinion 20 such that when the spur gear pinion 20 is in its non-braking position the contacts of the micro-switch will be maintained in a normally closed state. This provides an indication to the microcontroller 8 that the spur gear pinion 20 is in its non-braking position (i.e. healthy). The micro-switch is connected into the normal stop circuitry to provide an additional inhibit feature upon activation of the braking system. Resetting of the braking system returns the micro-switch to its normally closed state. The solenoid 27 is operably connected to the micro controller 8 so as to be actuated in dependence upon the micro controller.

Those teeth of the spur gear pinion 20 which may contact the rack 2 when the spur gear pinion 20 is in its braking position are coated with a thermo-melt coating 29.

The microcontroller 8 is programmed with the rated speed of the stair lift and with acceptable variations therefrom and these are converted to equivalent numbers of pulses. After an initial start up period the microcontroller 8 monitors the number of pulses being received from the opto switch 7 and compares this with the pre-programmed data. This data is preferably a range of acceptable values including a maximum value corresponding to a desired multiple of the rated speed of the stair lift and a minimum value corresponding to

a stair lift speed which is slightly greater than zero. In this case, provided that the pulse rate generated by the opto switch 7 is within this range of values, the micro controller 8 maintains the solenoid 27 in its energised state so that the pawl 23 is held, against the action of the torsion spring, in its first position where the abutment 28 is located between adjacent teeth of the spur gear pinion 20 thereby retaining the spur gear pinion 20 in its non-braking position. If zero pulses are detected (indicating a fault in the opto switch 7) or if a number of pulses greater than the maximum value is detected (indicating that the carriage is moving at an excessive speed), then the micro controller 8 de-energises the solenoid 27. This causes the pawl 23 to pivot about axle 24, in the direction indicated by arrow 30, to its second position where the abutment 28 is spaced from the teeth of the spur gear pinion 20. Thus the spur gear pinion 20 can then pivot about axle 21, under the influence of gravity and the torsion spring, so that it occupies its braking position where its coated teeth engage with the rack and halt the motion of the carriage 1 along the rack 2.

As a consequence of the spur gear pinion 20 being mounted eccentrically, once it is released from its non-braking position, it becomes self-locking in that the more the stair lift tries to travel in the downward direction indicated by arrow 31 the more the pinion 20 will try to engage with the rack 2. Eventually the pinion 20 will physically be unable to engage any further and will lock with the rack thereby bringing the stair lift to rest. The coating 29 on the spur gear pinion prevents bouncing of the spur gear pinion 20 on the rack 2 when the pinion 20 moves to its braking position and also absorbs the initial impact shock.

The above emergency braking sequence will also be

initiated in the event of a power failure or of a solenoid failure or if there is an open circuit condition to the opto switch.

It can be seen that the emergency braking system in accordance with the present invention is completely independent of the main drive system for the stair lift. Moreover, the system can be programmed so that it is activated at a speed of at least 115% of the rated stair lift speed or when the speed exceeds 0.3m per second as required by British Standard BS5776:1996. Moreover, all of the control circuits are designed to be failsafe as required by that British Standard in that, if there is a loss of power, the solenoid will disengage and the system will fail to safety. If the opto switch malfunctions the system will fail to safety. Moreover, no power is required to activate the braking system and the level at which the emergency braking system is activated can be accurately set by means of the software program of the microcontroller. Further, the software program can be such that the system is checked at every start command.

CLAIMS:

1. A braking system for preventing relative movement between a movable first member and a second member which system comprises:

(i) a means of generating a signal in the form of a series of pulses at a rate dependent upon the speed of movement of the first member with respect to the second member,

(ii) monitoring means for monitoring the signal and comparing it with a predetermined value, and

(iii) a braking device for preventing relative movement of the first and second members when the signal departs from the predetermined value.

2. A braking system as claimed in claim 1 wherein the pulses are optical pulses generated by chopping a light beam by means of an apertured disc rotating in the light beam at a speed dependent upon the speed of movement of the first member.

3. A braking system as claimed in claim 1 or 2 wherein the braking device comprises a toothed member eccentrically mounted on the first member so that the toothed member can move between a braking position in which it is engaged with a rack provided on the second member and thereby prevents relative movement of the first and second members and a non-braking position in which it is spaced from the rack.

4. A braking system for preventing relative movement between a movable first member and a second member which system comprises:-

(i) signal generating means for generating a signal corresponding to the speed of movement of the first member with respect to the second member,

(ii) monitoring means for monitoring the signal and comparing it with a predetermined value, and

(iii) a braking device for preventing relative movement of the first and second members when the signal departs from the predetermined value, said braking device comprising a toothed member eccentrically mounted on the first member so that the toothed member can move between a braking position in which it is engaged with a rack provided on the second member and thereby prevents relative movement of the first and second members and a non-braking position in which it is spaced from the rack.

5. A braking system as claimed in claim 3 or 4 and including a means to urge the toothed member towards its braking position.

6. A braking system as claimed in claim 3, 4 or 5 and including an abutment moveable between a position where it engages the toothed member and holds it in its non-braking position and a position where it is spaced from the toothed member.

7. A braking system as claimed in claim 6 wherein the abutment is biased towards the position where it is spaced from the toothed member.

8. A braking system as claimed in claim 6 or 7 wherein the abutment is operated by a solenoid.

9. A braking system as claimed in claim 8 wherein the solenoid is in its energised state when retaining the toothed member in its non-braking position.

10. A braking system as claimed in any one of claims 3 to 9 wherein that part of the toothed member

which contacts the rack when the toothed member is in its braking position is coated with impact absorbing material.

11. A braking system as claimed in claim 10 wherein the impact absorbing material is a thermoplastic plastics material.

12. A braking system as claimed in any preceding claim wherein the monitoring means is a microprocessor to which the signal is fed, the predetermined value is a range of predetermined values, and said microprocessor monitors the signal and determines whether or not it is within said range.

13. A braking system as claimed in claim 12 wherein said range may be preselected.

14. A braking system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

15. A stair lift comprising a stair lift carriage and a track along which the carriage moves, wherein the stair lift additionally includes a braking system as claimed in any preceding claim, said stair lift carriage constitutes said first member, and said track constitutes said second member.

Application No: GB 9916229.9 **Examiner:** Dave McMunn
Claims searched: 1-15 **Date of search:** 5 October 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B8L (LCD). F2E (ER).

Int Cl (Ed.6): B66B 9/06, 9/08.

Other: ONLINE : WPI, EPODOC, JAPIO.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,Y	GB 2,251,234 A	(DELMANN). See sensor 14 & eccentric lever 6.	X:1,2,15 Y:3,4, 12,13
X,Y	GB 2,231,028 A	(GRORUD BISON BEDE).See sensor 20 & lever 18	X:1,15 Y:2-5, 12,13
Y	GB 2,184,707 A	(EASE). See lines 117, page 1 to line 3, page 2	4,5,15
X,Y	GB 2,145,847 A	(WESTINGHOUSE). See sensor 30,32	X:1,2 Y:3,15
Y	GB 2,088,326 A	(CARRIMORE). Note eccentric lever 26	4,5,15
Y	US 4,046,226	(FLINCHBAUGH). Note eccentric levers 204, 208	4,5,15

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.